
MOLLUSCAN FAUNAS OF THE ORLETON MASTODON SITE,
MADISON COUNTY, OHIO

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THE SITE AND COLLECTION OF MATERIAL

Occurrence. The two molluscan faunas studied in this paper are from the Orleton farm, Somerford Township, Madison County, 2 miles west of Plumwood and about 23 miles from Columbus, Ohio. They were uncovered in excavations for a mastodon skeleton by members of the staff of the Ohio State Museum of Archeology. In order to ascertain the age of the mastodon remains as exactly as possible, all available evidence was used. Pollen analyses were made, the geological situation carefully examined, and specimens of wood, bone, and mollusk

shells submitted to the Institute of Nuclear Studies, Chicago, for carbon 14 determinations. The geological situation of the site has been studied by Dr. Richard P. Goldthwait and forms the object of a separate paper. Geological data in this paper will therefore be confined to those necessary for the understanding of the occurrence of the two faunas.

The exposure produced by the excavations consists of two lithologically distinct fossiliferous layers. They are underlain by till and overlain by 8 inches of disturbed soil. The lower layer, 22 inches thick, consists of gray, impure, clayey marl, with a plentiful molluscan fauna, together with ostracodes, vertebrate bones, and a few plant remains. The mastodon remains were found in this layer. The upper layer, 13 inches thick, consists of black, peat-like muck in which are found numerous shells of mollusks, ostracodes, plant remains, and dissociated and broken bones of small vertebrates. Henceforth, the upper and lower strata will be referred to as the "black layer" and the "gray layer" respectively.

Sampling. The material for this study was collected by Drs. R. P. Goldthwait and C. H. Summerson in December, 1949, while the excavations for the mastodon skeleton were progressing. Two large samples, one from each of the layers represented, were collected and turned over to the writer. Special care was taken to avoid mixing of material from each layer with the other while securing representative quantities from each of them, so that the material studied might reflect as exactly as possible the fauna of each sample.

Methods of study. Each sample was carefully weighed after drying for a few weeks in air. No attempt was made to remove all moisture from the samples since an air-dry weight was thought to be sufficiently representative. A measured quantity of each sample was then soaked in water, passed through sieves to remove the finer particles of silt without losing the mollusca. Sieves of sufficiently small mesh were used to retain all but the very smallest of fragments. This process yielded a large quantity of shells which was divided into fractions, separated unselectively so that a fair representation of the fauna would be found in each one. One of these fractions was then separated into species and the number of shells of each species counted. Next the proportion of each species found in the sample from each of the layers was reduced to a percentage of the total number of shells (table 1, columns 1 and 2) in order to compare the occurrence of each species in the two samples and other molluscan assemblages studied quantitatively. In order to arrive at a more correct estimate of each species from the ecologic standpoint, the comparative volume of individuals of each species was computed (table 1, columns 3 and 4). This was felt to be necessary since the abundance of a given species in a particular environment depends largely on the amount of food available for the individuals of this species. Even if it is assumed that the potential supply of individuals of a given species is unlimited, or at least limited only by the reproductive capacity of the species, it is obvious that the limited food supply will soon eliminate a large proportion of the potential population. Hence, the volume of the individual must be taken into account in estimating the favorable nature of an environment; percentage of individuals regardless of their size will be insufficient. Both the volume figures and the percentage counts are given here since published data on molluscan faunas usually include only the latter, less significant in the writer's opinion than figures taking volume into account.

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COMPOSITION OF FAUNAS

Before discussing this subject it may be well to emphasize the relative value of the data on which the study is based. No limnologist would confine his study

of the fauna of a present day lake to a single sample from one station, however large that sample may be. He would feel obliged to collect at many different stations to make sure that his sampling covers variations from place to place in the lake. Such a procedure is usually easy enough since most stations are accessible. In studying an extinct lake it would likewise be desirable to examine samples from more than one station but circumstances often make this impossible. Studies based on a single sample will reflect conditions obtaining in only a small portion of the habitat studied and the conclusions based on them are necessarily limited. On the other hand, they have some value and lack of exhaustive information should not prevent an attempt at their interpretation, providing their limitations are kept in mind. It is with these reservations that the following data are presented.

TABLE 1
Composition of Faunas

SPECIES	PERCENT OF TOTAL INDIVIDUALS		PERCENT OF TOTAL VOLUME	
	Gray	Black	Gray	Black
PELECYPODA:				
<i>Musculium</i> sp.....	0.11	1.02	5.73	2.58
<i>Pisidium</i> sp.....	73.40	2.63	51.23	2.58
<i>Sphaerium</i> sp.....	.....	1.51	.....	2.58
<i>Naiades</i> (fragments).....	traces	traces	traces	traces
GASTROPODA (freshwater):				
<i>Stagnicola palustris elodes</i> (Say).....	.....	0.41	.....	23.34
<i>Stagnicola lanceata</i> (Gould).....	0.02	0.22	11.72	4.77
<i>Fossaria galbana</i> (Say).....	13.05	6.90	12.05	7.74
<i>Helisoma trivolvis</i> (Say).....	0.01	0.45	2.31	35.02
<i>Planorbula armigera</i> (Say).....	.....	trace	.....	trace
<i>Gyraulus altissimus</i> (F. C. Baker).....	9.93	81.81	12.41	12.88
<i>Gyraulus crista</i> (Linn.).....	0.09	.....	trace	.....
<i>Menetus exacuus</i> (Say).....	0.14	3.10	1.52	1.29
<i>Physa gyrina</i> Say.....	1.02	0.97	2.15	1.41
<i>Ferrissia parallela</i> (Haldeman).....	.....	0.63	.....	0.73
<i>Valvata lewisi</i> Currier.....	2.23	0.20	0.87	2.94
GASTROPODA (land):				
<i>Oxyloma retusa</i> (Lea).....	.....	0.05	.....	1.38
<i>Succinea ovalis</i> Say.....	.....	0.02	.....	0.76
<i>Stenotrema monodon</i> (Rackett).....	.....	0.02	.....	trace
<i>Mesodon clausus</i> (Say).....	.....	0.02	.....	trace
<i>Hawaiiia minuscula</i> (Binney).....	.....	trace	.....	trace
<i>Vertigo ovata</i> (Say).....	trace	.....	trace	.....

The species represented in each of the two layers are shown in table 1, together with their abundance, expressed as a percentage of the total number of individuals and their relative volume. The figures are based on separation of 12,254 specimens from the gray layer and 5,755 specimens from the black layer. It will be noted that all the species found in the gray layer are also present in the black, but in different proportions and with the addition of several species not found in the gray layer. No illustration could be more convincing of the fallacy of comparing two faunas on the sole basis of the species represented, without regard to quantitative changes. Mollusca are able to exist under a variety of conditions (see below, Ecology and distribution of the species) but their abundance is an index of the suitability of an environment to their particular requirements. The gray layer could be termed one in which optimum conditions obtained for *Pisidium* spp. (73.4 percent of total individuals and 51.23 percent of total volume) and the

black layer one favorable especially for *Gyraulus altissimus* (81.8 percent of total individuals and 12.88 percent of total volume) although the two mollusks are found in both layers.

The ecologic significance of each fauna will be discussed in detail later. For the present it should be pointed out that the two faunas are remarkable for the absence of forms usually associated with those recorded, notably species of the genus *Amnicola*. Both may be interpreted as undeveloped faunas, *i.e.*, faunas not established for a sufficiently long time to permit the arrival into the environment of all species capable of thriving in it.

It will be seen that the importance of the species listed for the two faunas varies considerably. The writer assumes that the most significant species are those which form the largest proportions of the faunas, both in numbers of individuals and actual volume. For the two layers, the significant species are listed in table 2.

TABLE 2
Significant Species

<i>Gray layer</i>	<i>Black layer</i>
<i>Pisidium</i> spp.	<i>Gyraulus altissimus</i>
<i>Fossaria galbana</i>	<i>Fossaria galbana</i>
<i>Gyraulus altissimus</i>	<i>Helisoma trivolvis</i>
<i>Stagnicola lanceata</i>	<i>Stagnicola palustris elodes</i>

ECOLOGY AND DISTRIBUTION OF THE SPECIES

A cursory examination of the list of species in table 1 shows that the molluscan assemblage of both layers is a freshwater one. This is confirmed by the quantitative data, for in each assemblage the most abundant species are freshwater. In reconstructing the environment in which these mollusca lived and in estimating the age of the deposit in which they are preserved, a proper evaluation of the fauna must be made. The species on which most reliance will be placed are the ones listed in table 2 but this estimate must not neglect the lesser elements of the fauna for they too have something to contribute to the discussion.

The land snails of both lists (*Oxyloma retusa*, *Succinea ovalis*, *Stenotrema monodon*, *Mesodon clausus*, *Hawaiiia minuscula*, and *Vertigo ovata*) may be considered as intruders but in different degrees. For instance, *Oxyloma retusa* may be expected in freshwater assemblages for it lives in moist situations near the margins of streams, ponds, and lakes and sometimes ventures far out from shore, going from one stalk or leaf to another until it is far from dry land. Its presence in the black layer should therefore not occasion any surprise. *Succinea ovalis* is less amphibious in its habits and its presence in the black layer is best explained as a stray shell which rolled into the water from a drier habitat. The same remarks apply to the other land snails and their presence indicates nearness of a good forest cover not far from the lake or pond in which the freshwater mollusca lived at the time of the accumulation of the black layer.

It is from the strictly freshwater species and their comparative abundance that we derive the most telling information as to the environment in which the two deposits were formed. In order to make the basis of the conclusions clearer, data on the ecology and distribution, where available, are given for each species. This information is derived from many sources, not all readily accessible, and it is felt that its repetition here is preferable to mere references to the literature. Source of the data is given in each case except for pH and fixed carbon dioxide figures which are all quoted from Morrison (1932).

Musculium, Pisidium, and Sphaerium

The ecology of the species of these genera cannot be discussed here as it has been impossible for the writer to identify the several species to which they belong. The taxonomy of this difficult group is being revised at present by the Rev. Mr. H. B. Herrington but his studies have not progressed to the point where non-specialists can identify the species with certainty. In the absence of specific determinations, the mere mention of generic name is devoid of ecologic significance. Sphaeriidae may be found in all kinds of freshwater habitats although certain species appear to be partial to particular stations. Sufficient information may be gleaned from the gastropods, however, to identify the habitats represented by the two faunas.

Naiades

The Naiades, or freshwater mussels, are represented in the two collections by fragments which are almost unidentifiable. It may be surmised from the thinness of the fragments that they belong to a species of the genus *Anodonta* but there are other genera in which they might also be placed, e.g., *Strophitus* and *Alasmidonta*. Naiades, especially of the genus *Anodonta*, are frequently found in small lakes, as will be seen by the examination of the lists given (see "Comparison with other faunas").

Stagnicola palustris elodes (Say)

Baker (1932) has made a special study of the ecology of this subspecies. His findings may be summarized as follows: It inhabits both clear and stagnant water, but prefers a habitat in which the water is not in motion. Typical *elodes* is not usually found in swales but in lakes and rivers where the water is quiet and where vegetation is more or less abundant. The margins of rivers and protected bays of lakes and ponds appear to be its natural habitat. Baker (1928, p. 215) describes a typical habitat as follows: "Vegetation mostly *Typha*, with *Pontederia* and *Sagittaria*; animals in water from 0.3 to 1 meter deep, but most abundant in 0.3 m. at the edge of a pool, on mud bottom." Morrison found it in water with pH 7.4, fixed carbon dioxide 21.0 p.p.m.

The subspecies has a very wide distribution from New England west to the Rocky Mountains, and from Canada south to New Mexico.

Stagnicola lanceata (Gould)

There seems to be no significant difference between the habitat preferences of this species and those of *S. palustris elodes*. The wider range in pH (6.95 to 7.7) and fixed carbon dioxide (7.5 to 22.56 p.p.m.) may be due to more abundant data for *S. lanceata* than for *S. palustris elodes*.

The species has a very wide distribution at present, from northern Ohio west to Wisconsin, northward to the north shore of Lake Superior and eastern Ontario.

Fossaria galbana (Say)

Since this is an extinct species, its ecology may be inferred from that of *F. obrussa decampi* (Streng), a form of small, shallow lakes, whose pH range is 7.42 to 7.7 and fixed carbon dioxide range 10.65 to 18.87 p.p.m. and with that of *F. obrussa obrussa* (Say) found in both small and medium sized lakes with a somewhat greater range in pH (5.86 to 8.37) and fixed carbon dioxide (1.26 to 25.75 p.p.m.). Both species are closely related to *F. galbana* and both are widely distributed in the northern tier of states and Canada. The majority of the species of the genus *Fossaria* are semi-amphibious snails living in shallow water or on moist mud flats frequently out of water for considerable periods of time. Baker's (1928) notes on the ecology of these two forms is given for comparison: *F. obrussa obrussa* (p. 296): "The normal habitat of this species is in small bodies of water, as creeks, ponds, sloughs, bays, and marshy spots along river banks. It is at home on sticks, stones, and any other debris that may be in the water or along its edge." *F. obrussa decampi* (Streng), (p. 300): "The habitat of *decampi* is probably the same as that of *obrussa*." Both forms are widely distributed in North America, especially in the northern tier of states and Canada, although *F. obrussa obrussa* is found as far south as Arizona and northern Mexico.

Distribution. *Fossaria galbana* is found in marl and other deposits from New Jersey west to Wisconsin and northward into Canada.

Helisoma trivolvis (Say)

Ecology. Baker (1928, pp. 332-33) describes the ecology of this species as follows: "Typical *trivolvis* is always an inhabitant of quiet, more or less stagnant water. Many of the Wisconsin habitats have been formed behind beach barriers, and the *trivolvis* in such places is usually very large and fine. Specific habitats are as follows: Asylum Bay, Lake Winnebago, in marsh behind barrier beach, mud bottom, water .9 m. deep, vegetation thick and consisting of *Myriophyllum*, *Ceratophyllum*, *Elodea*, *Potamogeton*, *Typha*, and some *Scirpus*; algae very abundant and of the blanket form; Fox River at Omro, swampy shore fine sand bottom, water .5 m. deep; Green Lake, West Creek, 2 m. deep, mud bottom, shells on floating debris or on vegetation along shore; Lake Chetek, swamp behind beach, .8 m. deep, mud bottom, on logs and debris; Tomahawk Lake, in creek and swampy overflow protected from rough water of lake, mud bottom, water few cm. to 1 m. deep, on logs and shore. . . ."

pH 6.6 to 8.37; fixed carbon dioxide 7.5 to 30.56 p.p.m.

Distribution. (Baker, 1928) "Atlantic coast and Mississippi River drainages, northward to Arctic British America and Alaska and southward to Tennessee and Missouri. The southern distribution is not clear owing to mixing with related species."

Planorbula armigera (Say)

Ecology. (Baker, 1928, pp. 358-359) "*Planorbula armigera* is largely a species of swales or of small and stagnant bodies of water. Some of the specific habitats in Wisconsin are noted below; North of Oshkosh, in small pool beneath railroad track, mud bottom, water .3-.5 m. deep; Plummers Point, Lake Butte des Morts, woodland swale, water shallow, bottom meadow grass or mud; Devils Lake, marsh at southwest end, mud bottom, water .3-1 m. deep; small pool behind beach, Lake Chetek, shallow, with mud bottom; slough, west end Lake Chetek, soft mud bottom, water .3-1 m. deep, snails on deciduous logs, not on coniferous logs; pond behind beach, Wisconsin River, Oneida Co."

pH 6.6 to 7.6; fixed carbon dioxide 7.5 to 16.7 p.p.m.

Distribution. New England west to Nebraska, south to Georgia and Louisiana, north to Great Slave Lake.

Gyraulus altissimus (F. C. Baker)

Ecology. Since the species is extinct no precise ecologic data can be given except by inference from its close relative *G. arcticus* ("Beck" Möller) which also lives in small lakes with quiet water and abundant vegetation. Morrison (1932) has given figures (pH 8.37, fixed carbon dioxide 25.75 p.p.m.) for Mann Lake, Wisconsin, in which *G. arcticus* was collected. From its association with other species found both in Pleistocene and living faunas, it may be inferred that *G. altissimus* was a species of small lakes with a wide pH and fixed carbon dioxide range.

Distribution. Pleistocene deposits in Ohio, Indiana, Illinois, Michigan, Wisconsin, Ontario, and Quebec. Baker thinks it will also be found in other states.

Gyraulus crista (Linn.)

Ecology. The only ecological notes for this species in North America are those of Nylander (Nautilus, vol. X, p. 117) who, according to Baker (1928, p. 386) found it "in Barren Brook, Maine, in three or four inches of water under logs and bark. The writer has found it sparingly on dead leaves in stagnant water in small lakes in the company of *G. deflectus obliquus* but in much smaller numbers than that species." No pH or fixed carbon dioxide figures are available.

Distribution. Maine west to Alberta, Wisconsin, and Illinois. Living and fossil. Baker (1928, p. 386) states that "it was at one time believed to have been introduced from Europe, as it is widely distributed on the eastern continent, but its present widespread range in America indicates it to be indigenous or at least of very remote migration from Europe, if that be its center of dispersal. Its presence in Pleistocene deposits also indicates some degree of antiquity in America."

Menetus exacuons (Say)

Ecology. Baker (1928, pp. 362-63) found it "generally in quiet places, more or less marshy. Specific habitats: slough near west end of Lake Chetek, water .6 m. deep, bottom soft, sticky mud, from few cm. to .3 m. deep, snails on logs (not on coniferous logs). Chicago Creek, half mile above Lake Superior, on mud flat on edge of small mountain stream of clear, cold water. The *exacuons* were always found on the mud flats in quiet water while *Physa* and *Galba* were observed in the more rapid part of the stream, especially in the little falls and rapids."

pH 7.0 to 7.6; fixed carbon dioxide 9.3 to 22.5 p.p.m.

Distribution. Baker (1928, p. 363) records it for "United States east of Rocky Mountains, north to Alaska and the Mackenzie River, south to New Mexico."

Physa gyrina Say

Ecology. The species appears to be characteristic of slow-moving and stagnant bodies of shallow water, usually on a mud bottom. It has been found in overflows from large rivers, in small ponds behind river and lake beaches. (Condensed from Baker, 1928, pp. 451-52.)

pH 7.1 to 8.37; fixed carbon dioxide 9.5 to 25.75 p.p.m.

Distribution. (Baker, 1928, pp. 451-52) "From the Arctic regions south to Alabama and Texas. The typical form is characteristic of the Mississippi Valley where it reaches its greatest perfection."

Ferrissia parallela (Haldeman)

Ecology. This species is also an inhabitant of quiet water, on plants and the shells of Naiades, in shallow water from 0.3 to 2 m. in depth. The animal is usually found near the surface but may occur on the lower part of such plants as *Scirpus*, near the bottom. *Parallela* appears to be a pond or lake species, at least in Wisconsin. It is found on *Potamogeton*, *Nymphaea*, *Scirpus*, and *Castalia* leaves or on any smooth surface which is suitable for protection. (Condensed from Baker, 1928, p. 397.)

pH 6.05 to 8.37; fixed carbon dioxide 2.75 to 25.75 p.p.m.

Distribution. (Baker, 1928, p. 397) "Nova Scotia and New England west to Minnesota, Manitoba, south to Rhode Island, Central New York, Northern Ohio, and Indiana (Walker). A species of northern distribution. In Illinois it is recorded authentically from the north-eastern part, in Lake and McHenry counties."

Valvata lewisi Currier

Ecology. (Baker, 1928, p. 28) "Prairie Lake, shallow water, sand bottom, in vegetation; Lake Butte des Morts, 1 m., mud bottom, on plants. Apparently not found in as deep water as *sincera*. Also a lake species largely."

pH 7.6; fixed carbon dioxide 22.5 p.p.m.

Distribution. (Baker, 1928, p. 28) "Northern part of the United States from the Atlantic to the Pacific Oceans, northward, in British America, to the upper Mackenzie River. Its southward range is not fully known. It is recorded from La Salle Co., Ill."

Oxyloma retusa (Lea)

Ecology. (Goodrich, 1932, p. 38) "A species of the marshes and other wet places. It can be found upon partly submerged sticks, on rotting water weeds, and often high on the stems of cat-tails. Frequently, it is in the company of the nearly amphibious species of *Lymnaea*."

Distribution. Northern and Middle United States north into Ontario and Quebec to Yukon and British Columbia and east to Labrador and Maine.

Succinea ovalis Say

Ecology. (Goodrich, 1932, p. 39) "The snail prefers drier localities than those frequented by *retusa* and often is to be found among the weeds of the edges of upland pools. In wet seasons it has been seen ten or twelve feet above the ground upon the trunks of smooth-barked trees."

Distribution. Arkansas to Georgia and northward into Canada from Saskatchewan east to Newfoundland, Prince Edward Island, and Nova Scotia.

Stenotrema monodon (Rackett)

Ecology. (Goodrich, 1932, p. 18) "When found in the southeastern part of the state (Michigan), it is usually in quite damp places and occasionally in very large colonies . . . A subspecies, *fraterna* (Say) . . . is an upland form rather than a habitant of the margins of swamps and marshes."

Distribution. New York, Ontario, and Quebec, Michigan, Wisconsin, Minnesota, and South Dakota south to Maryland, Illinois, Indiana, Ohio, Missouri, and Kansas.

Mesodon clausus (Say)

Ecology. (Goodrich, 1932, p. 18) ". . . found on railroad embankments and among roadside weeds. Judging from the numbers of individuals occurring in such situations, *clausa* flourishes better in sunlit, and sometimes baking hot, places than in the densely shaded woods."

Distribution. Minnesota, Michigan, Illinois, Indiana, Ohio, and New York south to Alabama.

Hawaiiia minuscula (Binney)

Ecology. (Goodrich, 1932, p. 33) "Alive, it is to be found rarely in greater numbers than four or five individuals, usually by the borders of streams and lakes, but it is one of the commonest shells of the stream drift."

Distribution. Alaska and Northwest Territories of Canada south to British Columbia, east to Quebec and Maine, south to Florida and Texas.

Vertigo ovata Say

Ecology. (Franzen and Leonard, 1947, p. 355) "*Vertigo ovata*, although found in various parts of the state, lives only in moist environs afforded by shaded slopes near streams and shores of ponds. Its range in Kansas extends westward into the generally dry regions of the High Plains. In these regions are local ponds and streams, many of which are fed by artesian springs, along whose shaded slopes *V. ovata* is found, though not in great numbers."

Distribution. Labrador west to British Columbia, north to Alaska, south to Mexico, Florida, and the West Indies.

NATURE OF THE ENVIRONMENTS

General. With the reservations stated previously (see Composition of faunas) the following conclusions concerning the nature of the two environments may be stated. Both environments are similar to those found at present in small lakes and ponds. None of the species of exposed shores in large lakes occurs in either assemblage. Still less may these assemblages be interpreted as river assemblages unless it be in sheltered bays in sluggish streams with weed-choked, muddy bottoms. In addition to these characteristics which they share, the two faunas show marked differences which can also be interpreted in terms of changing environment.

Gray Layer. The molluscan fauna of this layer is remarkable for the paucity of species represented (see table 1). It consists of an overwhelming abundance of the shells of the small bivalve *Pisidium*, a mere sprinkling of the shells of its relative, *Musculium*, and a negligible proportion of Naiad fragments. Among the gastropods, the lymnaeid *Fossaria galbana* is the most abundant (13.08 percent), followed closely by the planorbid *Gyraulus altissimus* (9.93 percent). The other gastropods are much scarcer.

All the species found in this assemblage are represented in the black layer, but in different proportions. Their changing relative abundance from one layer to the other indicates a change in environmental conditions, natural in a small lake, which will be discussed later.

The assemblage is remarkable also for the absence of amnicolids. The environment of the gray layer was not unfavorable for operculates since one of them, *Valvata lewisi*, is represented. Amnicolids are found in most collections from marl in small or large lakes, from subarctic Canada to Wisconsin, Michigan,

Indiana, and Illinois. In only a few marl collections are the amnicolids absent, notably the New Milford, Connecticut, deposit studied by Cooper (1930) which is questionably of post-Wisconsin age, and the Urbana, Illinois, deposit (Baker, 1918, pp. 660-65) of early Wisconsin age. The latter deposit shares with the Orleton gray layer the absence of *Helisoma* other than *H. trivolvis* but not too much importance is attached to this fact for *Amnicola* and *H. anceps striatum* have been recorded from at least one other early Wisconsin deposit in Illinois (Baker, 1930, p. 389).

Compared with its immediate successor, the Orleton gray layer is remarkable for the absence of land species, even in small numbers. Only two specimens of *Vertigo ovata*, listed as "trace" in the table, were found in the gray layer. This may be interpreted as an indication either of larger size of the lake during the formation of the gray layer or the lack of forest cover in the immediate vicinity of the lake while the gray layer was being formed. With the limited data available at present, it is not possible to adopt one of these theories in preference to the other. The problem could be solved by the collection of samples of the molluscan fauna in other parts of the deposit and comparison of the species represented with those in the sample of the gray layer now available.

The molluscan assemblage of the gray layer suggests a small lake with comparatively deep water, 3 to 10 feet, perhaps deeper in its central portion, without any great abundance of vegetation but with a sufficient amount to provide cover and food for the species present in it. It was such an environment as one can imagine for a lake in its early history, when the water is clear and free of vegetation, when the outlet is just beginning to cut its bed downward and before the bed of the lake has been choked up with accumulated debris and its water level has been lowered by cutting down of the outlet. A modern parallel may be found in Chilcott Lake, Quebec (La Rocque, 1932) although Chilcott Lake is in a later stage of development, with a more abundant fauna. Such an environment is radically different from that in which the black layer was formed.

The absence of the species which should be present in the gray layer cannot readily be accounted for. Other similar faunas (see Comparison with other faunas) contain many genera not found in the gray layer. These were probably prevented from establishing themselves here because of barriers whose nature will not be known until more data are available on the Pleistocene mollusca of Ohio.

Black Layer. The sediments of the black layer by themselves indicate radically different conditions from those obtaining when the gray layer was formed. They suggest a muddy, spongy bottom, such as is found in the shallow bays of modern lakes or the weed-choked remnants of glacial lakes in the last stage of their existence when most of the lake is covered with shallow water from a few inches to three feet deep. The molluscan fauna, and especially the proportions in which the species are represented, confirm this hypothesis.

The molluscan fauna of the black layer consists of the same species which are found in the gray layer with the addition of several others and a marked change in the proportions of each species. The dominant forms here are no longer pelecypods but gastropods. Most numerous from the standpoint of numbers is the small planorbid *Gyraulus altissimus* (81.8 percent) and next in order of abundance is the small lymnaeid *Fossaria galbana* (6.90 percent). Another small planorbid, much less abundant than *G. altissimus*, but still an important element of the fauna, is *Menetus exacuous*. Less conspicuous in the percentage tables, but nevertheless important because of their large size, are the lymnaeids *Stagnicola palustris elodes* (23.34 percent by volume) and *S. lanceata* (4.77 percent by volume).

Amnicolids are absent here, as in the gray layer, but their absence appears to be perfectly natural in an environment which suggests shallow water, a deep, soft mud bottom, and more pond-like conditions than those of the gray layer.

The presence in the black layer of land snails, absent in the gray layer, indicates

nearness of shore and the presence, in the immediate vicinity of the lake, of a plentiful forest cover.

The absence of other species, especially *Aplexa hypnorum* (Linn.) typical of temporary ponds, indicates that the lake had not yet reached the last stages of its existence where it would have become a mere temporary pond, surrounded by forest and dry in summer. That sort of environment is suitable only for a small number of species of various families which have been noted and studied by a number of investigators but notably by Mozley (1938). If such a stage in the life of the lake had been reached, one would expect to find *Aplexa hypnorum* to be an important element of the fauna. The molluscan assemblage suggests, therefore, a small lake but a permanent one, whose bed had become choked with mud and vegetable debris and in which the water was mostly shallow but still present the year round. It is such an environment which can be found in many Ohio lakes in the late stage of development today.

COMPARISON WITH OTHER FAUNAS

The resemblances and differences between the fauna studied and others, both Pleistocene and living, are worthy of detailed treatment. The comparisons are made both from the standpoint of the nature of the environments of the two layers, already stated, and as a preliminary to the discussion of the age of the two faunas. The faunas compared have been selected so that comparisons might be made from three different aspects: geologic, geographic, and ecologic. These three factors must be considered in estimating the age of a Pleistocene molluscan assemblage, but they add considerably to the difficulty of arriving at definite conclusions. The faunas are arranged in two main groups (Living and Pleistocene) and under each of these the examples are given in order from south to north. In each list, the nomenclature has been brought up to date.

Living Faunas

Fisher's Pond, Middle Bass Island, Ohio. In his study of the molluscan fauna of Middle Bass Island, Dennis (1928) includes records of an assemblage similar to the Orleton faunas, especially the black layer, from Fisher's Pond. The pH was 7.4 and the species found in two of four zones are as follows:

Zone 1, at water line, water 2 inches deep, dense growth of water lilies. The substratum was muck. The snails found were in most cases clinging to the stem or the lower surface of the water lilies: *Helisoma trivolvis*, *Physa ancillaria*, *Fossaria humilis*, *Gyraulus parvus*, *Menetus exacuus*.

Zone 2, water 4 inches deep, dense growth of emergent vegetation (*Scirpus*); no snails.

Zone 3, water 5 inches deep, in another belt of water lilies like that in zone 1. The conditions were the same except that the water was 3 inches deeper in zone 3 than in zone 1: *Helisoma trivolvis*, *Physa ancillaria*, *Fossaria humilis*, *Gyraulus parvus*.

Zone 4, middle of pond, muck a foot deep, water 6 inches deep, dense growth of submerged vegetation; no snails.

The population of Fisher's Pond is poorer in number of species than that of even the gray layer, although the environment is almost the same in both cases. This one example from Ohio is given to show the variation which may exist between similar habitats geographically close together.

Pond near Canandaigua Lake, New York. The closest approach to the Orleton black layer is that of the type locality of *Stagnicola palustris elodes*, studied by Baker (1932). The pond was formed by the cutting off of a bay of the lake at a point 3 miles south of the city of Canandaigua; the area of the pool is given by Baker as about 3 acres. He describes the vegetation as follows: "There are three char-

acteristic zones of vegetation, (1) an outer belt of large forest trees; (2) a zone of bushes bordering the shore; and (3) a border of small water plants on the inner edge of the bushes." Baker found 14 species "living on the muddy bottom which was filled with plant debris serving as food, or on the vegetation that lined the shore and filled the deeper water." The molluscan fauna consists of the following species: *Stagnicola palustris elodes* (Say), *Sphaerium occidentale* Prime, *Musculium securis* (Prime), *Pisidium roperi* Sterki, *Valvata lewisi* Currier, *Helisoma pseudotrivolvis* (F. C. Baker), *Menetus exacuus* (Say), *Menetus rubellus* (Sterki), *Gyraulus deflectus obliquus* (DeKay), *Gyraulus arcticus* ("Beck" Möller), *Gyraulus parvus* (Say), *Gyraulus circumstriatus walkeri* (Vanatta), *Physa gyrina elliptica* Lea, *Aplexa hypnorum* (Linn.). Three land snails were also found on the shore and near the shallower parts of the pool: *Oxyloma retusa* (Lea), *Succinea avara* Say, *Zonitoides nitidus* (Müller).

Unfortunately, Baker did not give quantitative data for the several species but the agreement between his list and that of the black layer is striking. With the exception of *Aplexa hypnorum* (Linn.) the genera are the same and his list of land snails around the pool is suggestive of the origin of those found in small numbers in the black layer of the Orleton deposit.

TABLE 3

Occurrence of molluscan species in three environments of Meach Lake, Quebec

Species	Rock	Sand	Mud
<i>Musculium rosaceum</i> Prime.....	0*	r	0
<i>Pisidium</i> sp.....	0	r	0
<i>Anodonta marginata</i> Say.....	0	0	c
<i>Elliptio complanatus</i> (Dillwyn).....	r	r	0
<i>Lymnaea stagnalis lillianae</i> F. C. Baker.....	c	c	r
<i>Bulinnea megasoma</i> (Say).....	r	0	c
<i>Pseudosuccinea columella</i> (Say).....	0	0	c
<i>Gyraulus parvus</i> (Say).....	0	0	r
<i>Helisoma trivolvis pilsbryi</i> F.C.B.....	r	0	c
<i>H. campanulatum wisconsinense</i> (Winslow).....	c	c	c
<i>H. anceps latchfordi</i> (Pilsbry).....	r	c	r
<i>Physa latchfordi</i> F. C. Baker.....	c	c	0
<i>P. gyrina</i> Say.....	0	0	r
<i>Ferrissia parallela</i> (Say).....	0	0	c
<i>Amnicola limosa porata</i> (Say).....	0	0	c
<i>Campeloma</i> cf. <i>decisum</i> (Say).....	0	c	0
<i>Oxyloma retusa</i> (Lea).....	0	0	r

*c—common; r—rare; 0—absent.

Similar assemblages of mollusca are found far to the west of both Ohio and New York, and northward into Canada. A few examples will demonstrate the widespread occurrence of this kind of molluscan population.

Meach Lake, Quebec. The molluscan fauna of this lake was studied by La Rocque (1935). The condensed data in table 3 for the three environments of the lake will serve to show the similarities between the Orleton faunas and the mud habitat of Meach Lake and the different assemblages which are found in the rock and sand habitat of the same body of water.

Chilcott Lake, Quebec. This lake, west of Wakefield, Quebec, about 30 miles north of Ottawa, Ontario, was studied by La Rocque (1932). No quantitative data were obtained during the study but the list of species will show the character of the molluscan fauna which may be expected in a lake in an advanced stage of development and of somewhat larger size than that of the Orleton deposit:

PELECYPODA

Elliptio complanatus (Dillwyn)
Anodonta cataracta Say
Lasmsgona costata (Rafinesque)
Alasmidonta undulata (Say)
Musculium sp.
Sphaerium simile (Say)

GASTROPODA

Campeloma decisum (Say)
Ammicola limosa porata (Say)
Lymnaea stagnalis jugularis Say
Stagnicola emarginata canadensis (Sowerby)
Pseudosuccinea columella (Say)
Helisoma trivolvis (Say)
H. campanulatum (Say)
H. anceps (Menke)
Physa cf. *latchfordi* (F. C. Baker)

The disparities between the Chilcote Lake list and the Orleton deposit lists may be interpreted as due to differences in depth of water (deeper in Chilcote Lake), greater time for immigration of molluscan species, and connection of the lake with the Gatineau River, a tributary of the Ottawa, which in turn forms part of the St. Lawrence system.

Manitoba and Saskatchewan. The small lake fauna ranges much farther north and west than the examples so far cited would indicate. To give the full extent of its range, a few examples recorded by Mozley (1938) from Manitoba and Saskatchewan are given.

Small Freshwater Lakes: (1) A pond on Moose Mountain, southern Saskatchewan: *Lymnaea stagnalis jugularis*, *Stagnicola palustris*, *Helisoma trivolvis*, *Menetus exacuus*, *Physa gyrina*. (2) Pelican Lake, Ninette, Manitoba: (i) on *Potamogeton* near the centre of the lake, *Physa gyrina* (abundant), *Stagnicola palustris* (less common); (ii) in *Typha* and *Scirpus* marsh around the shore of the lake, *Lymnaea stagnalis jugularis*, *Stagnicola palustris*, *Menetus exacuus*, *Gyraulus arcticus*, *Planorbula armigera*, *Physa gyrina*; (iii) in a moist meadow on slightly higher ground near the marsh, *Stagnicola caperata*, *Fossaria parva* var., *Aplexa hypnorum*.

In this region, as well as in others, the molluscan fauna of small lakes differs from that of temporary ponds on the one hand and that of large lakes with outlet streams on the other. Two examples from Mozley's (1938) work will suffice to show the contrast:

Temporary pond near St. Vital, Manitoba: *Stagnicola palustris*, *S. caperata*, *Menetus exacuus*, *Gyraulus umbilicatellus*, *Planorbula campestris*, *P. crassilabris*, *Aplexa hypnorum*.

Large lake with outlet stream, Shoal Lake, eastern Manitoba: (i) Exposed rocky shores of Indian Bay, *Physa ancillaria*; (ii) sandy shore of Indian Bay somewhat exposed to wave action, *Lymnaea stagnalis lilliana*; (iii) protected shore of Indian Bay, *Fossaria obrussa exigua*; (iv) Falcon Bay in quiet water, on sand bottom and in small marshes, *Lymnaea stagnalis jugularis*, *Helisoma campanulatum wisconsinense*, *H. trivolvis pilsbryi*, *H. anceps sayi*, *Menetus exacuus*, *Gyraulus hirsutus*, *G. arcticus*, *Planorbula crassilabris*, *Sphaerium crassum*, *Anodonta kennicotti*.

In addition, the lists given by Russell (1934) cited later in this paper, should also be examined. They are not repeated here since they are quoted specially to show the relationships between interglacial, post-glacial, and living faunas in one region.

Pleistocene Faunas

Rush Lake, Ohio. Baker (1920) has studied the mollusca from a marl bed at the south end of Rush Lake, Logan County, Ohio. The bed is dated as post-Wisconsin in age and after examination of the list of species, Baker concludes that "the Ohio deposit may, therefore, be considered as having lived in a larger Rush Lake, perhaps not long after the ice had disappeared from Ohio." The list of species is of interest for comparison with the Orleton faunas:

- Anodonta* species—fragments
Sphaerium sulcatum (Lamarck)—abundant
Musculium rosaceum (Prime)—a dozen odd valves
Pisidium compressum Prime—common, almost abundant
P. variabile Prime—about as common as *P. compressum*
P. tenuissimum Sterki—the most abundant species of Sphaeriidae
P. medianum Sterki—a score
P. noveboracense Prime—2 valves
P. pauperculum Sterki—2 valves
Valvata tricarinata (Say)—one of the most abundant species; several hundred
V. tricarinata perconfusa Walker—about 10 percent of the carinate *Valvatas*
V. tricarinata unicarinata—a single specimen
V. sincera Say—3 specimens out of about 20,000
Ammicola walkeri Pilsbry—not common, about 50 in a quart of specimens
A. lustrica Pilsbry, var.—nearly 40 percent of total
A. winkleyi leightoni Baker—"Together with *Ammicola lustrica* variety, it is the most abundant species in this deposit."
Helisoma campanulatum (Say)—a dozen specimens
H. anceps (Menke)—"A fairly abundant species"
H. anceps striatum (Baker)—"about 10 percent of the *antrosus* (*anceps*) may be referred to this variety"
Gyraulus altissimus (F. C. Baker) "The common *Planorbis* of the marl deposits . . . after *Ammicola lustrica* and *A. winkleyi leightoni* is the most abundant shell in this deposit"
G. hirsutus Gould—a single specimen
Menetus exacuon (Say)—fairly common
Stagnicola palustris (Müller)—a single broken specimen
Fossaria obrussa decampi (Streng)—quite common
Physa anatina Lea—adults not common, immature shells are almost abundant
Ferrissia parallela (Haldeman)—a single specimen.

New Milford, Connecticut. The fauna of the New Milford deposit, studied by Cooper (1930), is thought to be post-Wisconsin, Wabash interval. The species are as follows:

<i>Sphaerium rhomboideum</i>	common
<i>Musculium partumeium</i>	rare
<i>Pisidium abditum</i>	very common
<i>P. contortum</i>	rare
<i>P. ferrugineum</i>	rarely common
<i>P. rotundatum</i>	rare
<i>P. ventricosum</i>	rarely common
<i>Valvata tricarinata</i>	rare
<i>Physa</i> cf. <i>heterostropha</i>	very rare
<i>P.</i> cf. <i>ancillaria</i>	very rare
<i>Ferrissia rivularis</i>	very rare
<i>Helisoma anceps striatum</i>	very rare
<i>H. campanulatum</i>	very common
<i>Gyraulus altissimus</i>	abundant
<i>G. deflectus</i>	rare
<i>Lymnaea stagnalis jugularis</i>	common
<i>Fossaria galbana</i>	very common
<i>F. obrussa decampi</i>	rare
<i>Vertigo ovata</i>	very rare

From the ecologic standpoint, this assemblage suggests slightly different conditions from those obtaining at the Orleton site. Comparison of the two

lists shows more similarity between the gray layer and the New Milford deposit than between the latter and the black layer. On the other hand, the species of *Helisoma*, *Ferrissia*, and *Valvata* are different and the New Milford deposit contains no *Stagnicolae*.

Toronto Interglacial Fauna. This fauna has been the object of a careful study by Baker, because of the concern of geologists regarding its age. No definite conclusions have been reached according to Baker (1931) who considers it either Yarmouth or Sangamon in age but who points out also that A. P. Coleman at various times considered it as of Sangamon, Aftonian, or Yarmouth age. The list of species of this fauna is given here to show the contrast between a Great Lakes fauna and that of a small lake or pond. The contrast is especially apparent in the abundance of Naiades, preponderantly thick-shelled, listed by Baker. No data on abundance are available.

Amblema rariplicata (Lamarck)
Ligumia recta (Lamarck)
Lampsilis siliquioidea rosacea (DeKay)
Elliptio dilatatus (Rafinesque) variety
Pleurobema coccineum solidum (Lea)
Lampsilis ventricosa (Barnes) variety
Obovaria olivaria (Rafinesque)
Anodonta grandis Say
Quadrula pustulosa (Lea)
Sphaerium n. sp.
S. emarginatum (Prime)
S. sulcatum (Lamarck)
S. solidulum (Prime)?

Pisidium compressum Prime
Pleurocera acutum Rafinesque, variety
Goniobasis haldemani Tryon
Stagnicola palustris elodes (Say)?
Gyraulus altissimus (F. C. Baker)
Helisoma anceps striatum (F. C. Baker)
Vancleaveia emarginata canadensis (F. C. Baker)
Cincinnatia cincinnatiensis (Anthony)
Physa niagarensis Lea
P. sayii Tappan
Birgella subglobosa (Say)
Valvata tricarinata (Say)
Campeloma rufum (Haldeman)

McKay Lake, Ottawa, Ontario. The list of species for this deposit is given here to indicate the northward range of the small-lake assemblage. Its fauna was studied by Whittaker (1921) who states that it is Recent and was deposited "just after the retreat of the last marine invasion." The list of species is similar to that of the Orleton deposit with a few important differences. For example, *Stagnicola palustris elodes* is not found in the McKay Lake deposits and they contain two species, *Helisoma anceps* (Menke) and *H. campanulatum* (Say) besides abundant specimens of *Amnicola limosa porata* Say which are not found in the Orleton faunas. Whittaker gives no quantitative information but the writer, from examination of material from McKay Lake, can vouch for the abundance of *Amnicola limosa porata*, *Valvata tricarinata*, and *Gyraulus altissimus* in the deposit. Whittaker's list follows:

Pisidium abditum Haldeman
Triodopsis albolabris Say
Stenotrema monodon (Rackett)
Anguispira alternata (Say)
Helicodiscus parallelus (Say)
Succinea ovalis Say
Fossaria obrussa (Say)

F. galbana (Say)
Helisoma anceps (Menke)
H. campanulatum (Say)
Gyraulus altissimus (F. C. Baker)
Physa gyrina Say
Amnicola limosa porata (Say)
Valvata tricarinata (Say)

North Mud Lake, Indiana. Blatchley and Ashley (1901, p. 226) have given a list from a marl deposit at North Mud Lake, Fulton County, Indiana. The list (table 4) is remarkable in that it is one of the few which includes quantitative data.

A comparison of table 4 with table 1 will show that there are important differences between the North Mud Lake fauna and the two Orleton faunas. Some of the differences may be more apparent than real, for example, in the genus *Gyraulus*,

for it is quite possible that the species recorded as *G. parvus* is really *G. altissimus*. There still remains, however, the fact that 50 percent of the North Mud Lake fauna consists of 3 species of *Amnicola* which indicates a habitat much richer in water vegetation than the Orleton gray layer and with deeper water than the Orleton black layer.

TABLE 4

Relative frequency of fauna from a marl deposit at North Mud Lake, Indiana

Species	Percent of total
<i>Stagnicola desidiosa</i> (Say).....	4
<i>Fossaria humilis</i> (Say).....	2
<i>Physa heterostropha</i> Say.....	12
<i>Helisoma trivolvis</i> (Say).....	5
<i>H. anceps</i> (Menke).....	3
<i>Menetus exacuus</i> (Say).....	1
<i>Gyraulus parvus</i> (Say).....	12
<i>Amnicola limosa</i> (Say).....	20
<i>A. cincinnatiensis</i> Anthony.....	20
<i>A. lustrica</i> (Say).....	10
<i>Sphaerium</i> sp. and other broken shells.....	11

TABLE 5

Occurrence of molluscan species in three kinds of assemblages

Species	1	2	3
	(Number of localities)		
<i>Pisidium</i> cf. <i>superius</i>	1	...	...
<i>P. cf. rotundatum</i>	2	...	...
<i>P. compressum</i>.....	...	1	...
<i>P. sp.</i>	2	0	1
<i>Sphaerium simile</i>	0	1	0
<i>Lymnaea stagnalis jugularis</i>	0	0	4
<i>L. stagnalis</i> subsp. indet.....	0	1	0
<i>Stagnicola palustris elodes</i>	1	1	2
<i>S. palustris nuttalliana</i>	2	1	3
<i>S. saskatchewanensis</i>	1	0	0
<i>S. emarginata canadensis</i>	2	0	0
<i>Stagnicola</i> n. sp.....	1	0	0
<i>Gyraulus altissimus</i>	2	2	1
<i>G. cyclostomus</i>	3	0	1
<i>Helisoma subcrenatum</i>	0	1	5
<i>H. anceps striatum</i>	0	1	0
<i>Physa gyrina</i>	1	0	1
<i>Physa heterostropha</i>	0	1	0
<i>Aplexa hypnorum</i>	0	0	1
<i>Euconulus fulvus</i>	0	0	1
<i>Succinea chrysis</i>	0	1	1
<i>Succinea grosvenori</i>	0	0	1

Explanation of symbols:

Column 1: Interglacial (probably Peorian), 5 localities.

Column 2: Post-glacial, 2 localities.

Column 3: Living, 6 localities.

Bellflower, Illinois. Baker (1930, p. 389) has given a list of species from a deposit near Bellflower, McLean County, Illinois, which he estimates to be "Early Wisconsin, substage 1 of Leverett." It is of special interest because it yielded a

new record of *Castoroides ohioensis* for Illinois. There is no record of the relative abundance of the species and the list is reproduced here merely to show the variety of molluscan species represented.

Sphaerium sulcatum

Pisidium sp.

Valvata tricarinata

Amnicola leightoni var.

Cincinnatia cincinnatiensis

Pyrgulopsis sp.

Pomatiopsis scalaris

Helisoma anceps striatum

Gyraulus altissimus

G. urbanensis

Ferrissia parallela

Urbana, Illinois. The Urbana deposit, studied by Baker (1918, p. 661), is also Early Wisconsin in age. The deposit is in the Champaign till sheet in a kettle hole on the north side of the Champaign moraine. The fauna shows some affinities with that of the Orleton black layer. The list, together with Baker's indications of abundance, follows:

Sphaerium rhomboideum—1 right valve

S. occidentale—1 valve

Musculium cf. *rosaceum*—1 valve

M. truncatum—rather plentiful

Pisidium adamsi affine—1 valve

P. contortum—?

P. costatum—most abundant next to *P. tenuissimum calcareum*

P. tenuissimum calcareum—most abundant mollusk

P. variabile—1 valve

P. vesiculare—a few

Valvata sincera—quite common

V. tricarinata—not common

Physa gyrina—in abundance; only 3 percent mature

P. sayii—1 specimen

Helisoma trivolvis—not common

Gyraulus urbanensis—"sparingly"

G. altissimus—"a few adult individuals and a number young and immature specimens"

Stagnicola caperata—numerous

S. reflexa—occurs plentifully

Fossaria obrussa decampi—common

Winnipeg, Manitoba. A deposit from near Winnipeg, Manitoba, Canada, studied by Mozley (1928) is post-glacial in age. It is given here mainly because of its resemblance to the Orleton fauna in spite of the distance which separates the two deposits and the indications of comparative abundance given by Mozley.

Vallonia costata (Müller)—not common

V. parvula Sterki—rare

Retinella hammonis (Ström)—no data

Discus cronkhitei anthonyi Pilsbry—no data

Succinea ovalis Say—no data

Succinea sp.—no data

Fossaria obrussa exigua (Lea)—rare

Stagnicola vahllei arctica (Lea)—rare

S. caperata (Say)?—no data

Gyraulus parvus (Say)—not common

Helisoma trivolvis ? (Say)

Planorbula crassilabris Walker—no data

Aplexa hypnorum Say—no data

Physa integra Haldeman—no data

Amnicola limosa Say—no data
A. emarginata Küster—the most abundant species, very common
Amnicola winkleyi mozleyi Walker—common
Valvata tricarinata Say—no data
Ferrissia rivularis (Say)—no data
Sphaerium striatinum (Lamarck)—no data
S. solidulum Prime—no data
S. stamineum Conrad—no data
S. notatum Sterki—no data
S. emarginatum Prime—no data
S. torsum Sterki—no data
Pisidium fallax Sterki—no data
P. compressum Prime—no data
Musculium transversum Prime—no data

Southern Saskatchewan. The lists given by Russell (1934) for several localities in southern Saskatchewan are particularly interesting because they include interglacial, post-glacial, and living assemblages. The data comparing the three kinds of assemblages are condensed in table 5.

AGE OF THE FAUNA

The age of the Orleton faunas can definitely be stated as Wisconsin because of the presence in them of extinct species such as *Fossaria galbana* and *Gyraulus altissimus* although this statement must be qualified by noting that *G. altissimus*, although extinct in Ohio and the neighboring regions, may still be living (Russell, 1934) in southern Saskatchewan and perhaps northward. The presence in both lists of species still living in Ohio or in the same latitude in other states would indicate a late Wisconsin age. However, it must be admitted that the age determination based on the mollusca alone is far from certain because of the close similarity between Pleistocene and living faunas. In fact, the molluscan assemblage yields more information as to the environment under which the two layers were accumulated than concerning their relative age. This is due in part at least to our lack of knowledge of Pleistocene faunas, especially from a quantitative and stratigraphic standpoint.

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